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SB 397

Wolves of the Rockies
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Wolves of the Rockies

The wolf issue: science, the players, and our role.

I will briefly sample a few recent studies, many of which were enabled by wolf restoration, that may inform the issue of wolf management in the greater Yellowstone area. Then I'll discuss the way the wolf issue is playing out in Montana, and how we can get involved.

It may be useful to put three issues in perspective before we move on to the science that suggests a fresh look at our relationship to wolves: livestock depredation, human safety, and effects on big game hunting.

About 2.6 million cattle, including calves, live in Montana. Seventy-four killed by wolves in 2011 out of 2.6 million is less than 0.003 percent. Western Montana, where most wolves live, has fewer cattle than the east side of the state. As of 2009, there were 494,100 cattle there. Seventy-four of these animals were killed by wolves, or less than 0.015 percent of the western Montana cattle population. Similar percentages apply to sheep. There were approximately 33,000 sheep, including lambs, in western Montana in 2009. Wolves were documented to have killed 11 of these animals, or 0.03 percent, in 2011. In that same year, 64 wolves were killed in response, plus 166 were taken in the 2011 hunt, leaving 653 at year's end (Mallonee, 2011). This is not to say that the loss of a teenager's 4H calf or a small operator's animals are not devastating; just that the industry is not at risk. Keefover (2012) compared Montana cattle losses reported to NASS (USDA 2011) versus those verified by USDI Fish and Wildlife Service (USDI 2011). NASS, 1,293; FWS, 87; a difference of 1486%. From 1987 to 2010, Defenders of Wildlife provided a wolf compensation program to reimburse ranchers for livestock lost to wolves. In 23 years, they invested more than $1.4 million in an effort to build trust and promote tolerance within the livestock community. The state is compensating now, using federal funds. Meanwhile, federal agencies spend at least $123 million a year to keep U.S. public lands open to livestock grazing, and Wildlife Services spends $126.5 million annually to kill wolves and other animals on behalf of agriculture.

Another bogus issue is the danger that wolves pose to humans. During a 4 year period last decade, livestock killed 108 people in 4 states, and this does not include people killed by vehicle and cattle interactions (CDC, 2009). During this same time period, wild wolves in the lower 48 states killed no one. In the last 80 years, two fatalities, one in Saskatchewan, and one in Alaska, may have been wolf-caused.

As of late 2012, the Montana elk population statewide was doing well, with numbers at a count of 112,862, for an estimated 141,078. The state management objective calls for 90,910, so they are 50,168 elk over objective. That is 55% over objective.

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Montana Fish, Wildlife and Parks researchers and several scientists from MSU have contributed to our knowledge of large predator effects on the Gallatin elk herd. Hamlin and Cunningham (2009) concluded:

"Even where intensive data has been collected, there has been scientific and public debate concerning the impacts of wolf restoration on ungulate populations. Disagreement generally does not occur about the fact of declines in numbers of some ungulate populations, but disagreement about cause(s) or proportional shares of cause continues to exist." And, "Nowhere are data adequate to 'scientifically' assign cause(s) for any declines that may occur."

There is no doubt that wolves eat elk, and that their predation lowers the numbers of elk on the landscape, besides affecting their behavior. But how does that affect hunting? In his masters thesis, The Impact of wolves on Elk Hunting in Montana, MSU graduate student Steven Hazen (2012) wrote, "Since wolves primarily prey on big game, Montana's hunting industry will likely be impacted in various ways.*** Overall, wolves decrease hunter applications by 19.9% of the standard deviation in the southwest and 2.9% of the standard deviation in the west central region. This corresponds to 286 fewer applications in the southwest, but only 6 fewer in west central Montana... (U)sing the current data available wolves are not having a significant effect on elk harvest in Montana. On the other hand, they are shifting demand in the southwest region from areas in close proximity to the border of YNP to areas farther away." (Montana sold 235,600 big game hunting licenses in 2012.)

Brodie et al (2013) wrote, "We have limited understanding of the relative influence of carnivores, harvest, weather and forage availability on elk Cervus elaphus demography, despite the ecological and economic importance of this species. We assessed adult female survival, a key vital rate for population dynamics, from 2746 radio-collared elk in 45 populations across western North America that experience wide variation in carnivore assemblage, harvest, weather and habitat conditions.

2. Proportional hazard analysis revealed that 'baseline' (i.e. not related to human factors) mortality was higher with very high winter precipitation, particularly in populations sympatric with wolves Canis lupus. Mortality may increase via nutritional stress and heightened vulnerability to predation in snowy winters. Baseline mortality was unrelated to puma Pumaconcolor presence, forest cover or summer forage productivity.

3. Cause-specific mortality analyses showed that wolves and all carnivore species combined had additive effects on baseline elk mortality, but only reduced survival by <2%. When human factors were included, 'total' adult mortality was solely related to harvest; the influence of native carnivores was compensatory. Annual total mortality rates were lowest in populations sympatric with both pumas and wolves."

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Now, what about hunting and trapping wolves along the borders of Yellowstone National Park, which contains the only unexploited wolf population in the region? You might say that the loss of fifteen wolves from the Yellowstone National Park population of 88 (now about 71-78) is not significant. But you would be failing to consider a number of important factors. Hardly insignificant is the cost to science of losing seven radio-collared wolves whose collaring cost Yellowstone Park Foundation donors about $21,000. Those wolves were integral to the longest continuous studies of wolf population dynamics and wolf-elk relationships in the world, all in a uniquely complete suite of naturally present carnivores. Those studies are reported annually by the Yellowstone Wolf Project Smith et al(2012), and published in many peer-reviewed journals. They are yielding a wealth of information essential to managing the national park to preserve natural processes. Those studies also constitute a control or baseline of data to compare wolf/prey interactions between those of an unexploited population and those that are being hunted and trapped in surrounding states. No other area is large enough - Glacier and Grand Teton are too small to function that way. Are citizens of the tri-state greater Yellowstone area willing to sacrifice all that for a few hundred dollars in wolf license fees?

Aldo Leopold (1944) recognized that Yellowstone National Park was not large enough by itself to conserve a wolf population. In his review of Young and Goldman's The Wolves of North America, he took the authors to task for asserting, "There still remain...some areas of considerable size in which...(wolves) may be allowed to continue their existence without molestation." But then he asked, "Where are these areas? Probably every reasonable ecologist will agree that some of them should lie in the larger national parks and wilderness areas; for instance, the Yellowstone and its adjacent national forests."

Hunters plead for "scientific management" of wildlife in Montana. Yet, they choose to ignore peer-reviewed studies such as one from 2005: Vucetich and others wrote: "In the period following wolf reintroduction to YNP (1995-2004), the northern Yellowstone elk herd declined from ~17,000 to ~8,000 elk (8.1% yr). The extent to which wolf predation contributed to this decline is not obvious because the influence of other factors (human harvest and lower than average annual rainfall) on elk dynamics has not been quantified. According to the best model,which accounts for harvest rate and climate, the elk population would have been expected to decline by 7.9% per year... (C)limate and harvest rate are justified explanations for most of the observed elk decline."

More recently, Arthur Middleton (2012) conducted research on elk and wolves in the Sunlight Basin area of Wyoming. He concluded that a reduction of elk forage quality in summer due to rising temperatures, combined with higher grizzly predation pressure (41% of calves killed by grizzlies) is responsible for a reduction in migratory elk herds in this area. There has been an astounding 8 degree rise in July temperature in Yellowstone in the past few decades.

Now, about that elk calf predation. In an ongoing University of Montana-MT FWP study, Mark Hebblewhite and Kelly Proffitt tagged 66 elk calves in spring 2011 in the southern Bitterroot. They found that, in the following six months, of the 49 that died or lost their tags, 22 were killed by cougars, 11 by black bears, and two by wolves. The fate of the others were undetermined. In 2012, 50 staff and volunteers collared another 76 elk calves. Of the 55 known-fate calves, 35 are alive and 20 are dead. Similar to summer 2011, lion predation continues to be the predominant source of calf mortality. Of the 20 documented mortalities, mortality sources include lion predation (6), black bear predation (4), wolf predation (1), unknown predator (3), natural-non predation causes (2), and unknown causes (4).

Griffin et al (2011) used data from 1999 radio-marked neonatal elk (Cervus elaphus) calves from 12 populations in the northwestern United States to test for effects of predation on neonatal survival, and whether predation interacted with climate to render mortality compensatory. Neonatal elk survival to 3 months declined following hotter previous summers and increased with higher May precipitation, especially in areas with wolves and / or grizzly bears. Mortality hazards were significantly lower in systems with only coyotes (Canis latrans), cougars (Puma concolor) and black bears (Ursus americanus) compared to higher mortality hazards experienced with gray wolves (Canis lupus) and grizzly bears (Ursus horribilis). In systems with wolves and grizzly bears, mortality by cougars decreased, and predation by bears was the dominant cause of neonatal mortality. Only bear predation appeared additive and occurred earlier than other predators, which may render later mortality by other predators compensatory as calves age. Wolf predation was low and most likely a compensatory source of mortality for neonatal elk calves.

Perhaps we should think about the effects of wolf restoration on something other than elk. In 2009, Prugh et al wrote in BioScience that, "Apex predators have experienced catastrophic declines throughout the world as a result of human persecution and habitat loss. These collapses in top predator [wolf] populations are commonly associated with dramatic increases in the abundance of smaller predators. [coyotes, foxes, skunks, raccoons] (T)his trophic interaction has been recorded across a range of communities and ecosystems. Mesopredator outbreaks often lead to declining prey populations, sometimes destabilizing communities and driving local extinctions....—mesopredator outbreaks are causing high ecological, economic, and social costs around the world."

Eisenberg (2012) looked at three different densities of wolves (high, medium, and low) in elk winter range. She found elk numbers high in the three areas, regardless of wolf population level. She also found that wolves had a strong behavioral effect on elk, making them more wary. Elk avoided aspen stands that had burned. She found a trophic cascade relationship, in that aspen stands that had burned, which were being used significantly less by elk, due to predation risk factors, showed a strong release in herbivory and recruitment of aspen trees into the canopy. In her book The Wolf's Tooth: Keystone

Predators, Trophic Cascades and Biodiversity, Eisenberg found that keystone predators in ecosystems worldwide have been identified as increasing biodiversity, making ecosystems more resilient to climate change and stresses on wildlife caused by a growing human population. Eisenberg et al (2013) provide a critical review of trophic cascades involving wolves, elk, and aspen throughout the northern Rockies. While wolf effects varied from study to study, Eisenberg et al (2013) concluded that the scientific evidence indicates that aspen management strategies should incorporate what we are learning about wolf→elk→aspen food webs. Wolves can have powerful effects in food webs. These effects have been linked to aspen recruitment. Therefore, applying the precautionary principle to create healthier, more resilient aspen forests suggests conserving apex predators.

And how does all this affect birds? In a 2001 study, Joel Berger et al demonstrated "a cascade of ecological events that were triggered by the local extinction of grizzly bears...and wolves from the southern greater Yellowstone ecosystem." In about 75 years, moose in Grand Teton National Park erupted to five times the population outside, changed willow structure and density, and eliminated neotropical birds; Gray Catbirds and MacGillivray's Warblers.

In Yellowstone,s Lamar Valley, the average number of ravens observed per carcass pre-wolf restoration was four. Dan Stahler (2000) reported 135 on one wolf-killed carcass. Eagles averaged one per four carcasses pre-wolf. Dan saw 12 eagles and 65 ravens on one wolf kill.

Mark Hebblewhite and Doug Smith (2010) listed species they observed on 221 ungulate prey carcasses between 1995 and 2000 that were killed by wolves. In Banff National Park, they tallied 20 species: Most common were ravens (present at 96% of all kills), coyote (51%), black-billed magpie (19%), pine marten (14%), wolverine (8%), and bald eagles (8%); others, in descending order, were gray jay, golden eagle, long- and short-tailed weasel and least weasel, mink, lynx, cougar, grizzly bear, boreal and mountain chickadee, Clark's nutcracker, masked shrew, and great grey owl. In Yellowstone, they noted twelve scavengers, of which five visit virtually every kill: coyotes, ravens, magpies, and golden and bald eagles. More species of beetles use carcasses than all vertebrates put together. Sikes (1994) found 23,365 beetles of 445 species in two field seasons at wolf-killed carcasses. No predator feeds as many other creatures as wolves do.

Lisa Baril of MSU (2011) tells us that after nearly a century of height suppression, willows (Salix spp.) in the northern range of Yellowstone are increasing in height growth as a possible consequence of wolf (Canis lupus) restoration, climate change, or other factors... (T)he recent release of this rare but important habitat type could have significant implications for associated songbirds that are exhibiting declines in the region. *** Bird richness increased along a gradient from lowest in suppressed to highest in previously tall willows, but abundance and diversity were similar between released and previously tall willows. Common Yellowthroat (Geothlypis trichas) and Lincoln's Sparrow (Melospiza lincolnii) were found in all three growth conditions; however, Yellow Warbler (Dendroica petechia), Warbling Vireo (Vireo gilvus), Willow Flycatcher (Empidonax traillii), and Song Sparrow (Melospiza melodii) were present in released and previously tall willows only. Wilson's Warbler (Wilsonia pusilla) was found...to specialize on tall, dense willows.

Some people ask, "Does Montana have too many wolves?" In 1884, Montana set a bounty on wolves; in the next three years, 10,261 wolves were bountied (Lopez, 1978). That's16 times Montana's 2011 population of 653 wolves. Bergstrom et al (2009) question that having gray wolves over 2% of their former range in the conterminous United States, and at a tiny fraction of their former number constitutes recovery. They wonder at the wisdom of reducing them just a decade or two after they have been back on the land. The large historic population size of about 380,000 grey wolves implied by genetic data provides a striking contrast to restoration goals in the western conterminous US (Leonard et al, 2005).

Is wolf hunting necessary? Cariappa et al (2011) analyzed data collected at 32 sites across North America using linear and nonlinear regression and found that the evidence supported wolf population regulation by density-dependence as much as limitation by prey availability. The data suggested that wolf populations are self regulated rather than limited by prey biomass by at least a 3:1 margin. They wrote: "In establishing goals for sustainable wolf population levels, managers of wolf reintroductions and species recovery efforts should account for the possibility that some regulatory mechanism plays an important role in wolf population dynamics." (The 32 study sites were in the northern part of the United States and Canada. The recently reintroduced wolves in the northern Rockies and the southwest were not included because these populations are still growing.) What if we simply allowed wolves to regulate their own numbers, as they have in Yellowstone, going from 174 wolves in 2003 to about 80 in 2012?

And, can hunting be overdone? Scott Creel and Jay Rotella (2010) wrote, "Following the growth and geographic expansion of wolf (Canis lupus) populations reintroduced to Yellowstone National Park and central Idaho in 1995–1996, Rocky Mountain wolves were removed from the endangered species list in May 2009. Idaho and Montana immediately established hunting seasons with quotas equaling 20% of the regional wolf population. Combining hunting with predator control, 37.1% of Montana and Idaho wolves were killed in the year of delisting. Hunting and predator control are well-established methods to broaden societal acceptance of large carnivores, but it is unprecedented for a species to move so rapidly from protection under the Endangered Species Act to heavy direct harvest, and it is important to use all available data to assess the likely consequences of these changes in policy. For wolves, it is widely argued that human offtake has little effect on total mortality rates, so that a harvest of 28–50% per year can be sustained. Using previously published data from 21 North American wolf populations, we related total annual mortality and population growth to annual human offtake.

Contrary to current conventional wisdom, there was a strong association between human offtake and total mortality rates across North American wolf populations. Human offtake was associated with a strongly additive or super-additive increase in total mortality. Population growth declined as human offtake increased, even at low rates of offtake. Finally, wolf populations declined with harvests substantially lower than the thresholds identified in current state and federal policies. These results should help to inform management of Rocky Mountain wolves."

Gude et al (2012) replicated Creel and Rotella's analyses for those years in which field monitoring was consistent, using data from 27 area-years of intensive wolf monitoring in the northern Rocky Mountains, and showed that variation in both recruitment and human-caused mortality affect annual population growth rates; also that human-caused mortality rates have increased with the sizes of the wolf population. They rebut Creel and Rotella, writing: "Estimates of positive wolf population growth in Montana from our top models are consistent with field observations and estimates previously made for 2008-10, whereas the predictions for declining wolf populations of Creel and Rotella (2010) are not."

Stahler et al (2012), using 14 years of data from a long-term study of wolves in Yellowstone, noted, "At the population level, litter size and survival decreased with increasing wolf population size and canine distemper outbreaks." In the annual report (2011) of the Yellowstone wolf project, we read: "Intraspecific mortality was again the leading cause (of wolf deaths)." Flatly put, when wolf populations rise, wolves kill each other.

Other consequences of killing wolves include the effects on the social dynamics resulting from the loss of key pack members: if an alpha female is killed, that pack is unlikely to reproduce that year. If a pack's only big male is killed, that may result in diminishing the pack's food base, because big males are key to killing prey located and chased down by other pack members (Smith, pers. comm.).

To inform managers of recovering wolf populations about the impacts of the loss of breeders, Brainerd et al (2006) pooled data from 134 cases of breeder loss on 148 territorial breeding wolves. They assessed effects on pup survival, reproduction, and territorial social groups. In 84% of cases, at least one pup survived. More pups (90%) survived loss of breeders in groups of 6 or more wolves, compared with 60% in smaller groups. Auxiliary nonbreeders helped pups survive in 92% of cases; in their absence, pups survived in only 64% of cases. The number of adult-sized wolves remaining after breeder loss, along with pup age, had the greatest influence on pup survival. Territorial wolves bred the following season in 47% of cases; when one reproducer had to be replaced, 56% bred, but when both breeders had to be replaced, only 9% bred the following season. Wolf social groups dissolved and abandoned their territories in 38% of cases. Where groups dissolved, wolves re-established territories in 53% of cases, and neighboring packs usurped territories in 21% of cases. Just 26% of groups dissolved where breeders remained, versus 85% that broke up where breeders were absent. To minimize negative impacts on recolonizing wolf populations, the authors recommended that managers limit lethal control to solitary individuals or territorial pairs, because selective removal of pack members can be difficult, and remove wolves from reproductive packs when pups are 6 months or older, and from packs that contain 6 or more pack members.

Rutledge et al (2010) wrote, "Legal and illegal killing of animals near park borders can significantly increase the threat of extirpation for populations living within ecological reserves, especially for wide-ranging large carnivores that regularly travel into unprotected areas." And, "Our results indicate that even in a relatively large protected area, human harvesting outside park boundaries can affect evolutionarily important social patterns within protected areas." This study was conducted in Algonquin National Park, Ontario, where wolves carry coyote DNA. However, if these principles apply to Yellowstone wolves, the loss of similar social patterns would negate the value of Yellowstone as a control or baseline against which other areas, where wolf hunting is allowed, can be compared.

Should we control wolves? Biologist Bob Hayes offers some thoughts about controlling wolves in his 2010 book, Wolves of the Yukon. He wrote: "I spent eighteen years studying the effects of lethal wolf control on prey populations. The science clearly shows killing wolves is biologically wrong." As I began to better understand the wolf, I developed a clear answer to my question about the effectiveness and moral validity of lethal wolf control programs." A decade after his retirement in 2000, Hayes wrote, "I can now say the benefits of broad scale killing of wolves are far from worth it - not to moose, caribou, Dall's sheep or people. It should never happen again."

We should also consider the services that wolves provide, that can avert epidemics of wildlife diseases. Bruce L. Smith, in his 2012 book, Where Elk Roam, warns us of the danger of concentrating elk on feed grounds, because of two serious diseases: brucellosis and chronic wasting disease (CWD). Noting that Wisconsin has spent $27 million depopulating its whitetail deer to curb CWD (and no CWD has been detected where wolves live), he traces the inexorable march of CWD across Wyoming. "Recent modeling suggests wolf predation may suppress CWD emergence in deer."

Wolves and other large carnivores are essential to the health of the ecosystems on which our game animals and we depend. Wolves have been shown to be capable of reducing or eliminating the spread of brucellosis and chronic wasting disease (Hobbs 2006, Wild et al 2011), in part by reducing density and group sizes of elk and deer. Wild et al concluded, "We suggest that as CWD distribution and wolf range overlap in the future, wolf predation may suppress disease emergence or limit prevalence." Cross et al (2010) wrote, "(T)he data suggest that enhanced elk-to-elk transmission in free-ranging populations may be occurring due to larger winter elk aggregations. Elk populations inside and outside of the GYE that traditionally did not maintain brucellosis may now be at risk due to recent population increases."

We risk losing wolves' essential ecosystem services by continually inventing new ways to reduce their numbers to a socially-acceptable minimum. The goal of wolf management might better be to establish ecologically effective populations of wolves (Lee et al. 2012) wherever the absence of conflicts with livestock make that feasible .

It may be timely to consider the ethical ramifications of our relationship with wolves and other large predators. Aldo Leopold was a Yale School of Forestry graduate of 1909; he was the father of wildlife management in America. Leopold thought of ecosystems, including all their inhabitants and processes, as "The land." He wrote (1949), "We abuse land because we see it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect." He also wrote, "If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering."

Bruskotter et al (2011) offer a way to rescue wolves from politics, by adopting wildlife as a public trust resource. They write, "In the absence of ESA protection, wolf management reverts to states. Will states honor the substantial public investment made in wolf restoration or seek to dramatically reduce or even eliminate wolf populations, as opponents of delisting claim? The answer may depend on how states interpret a legal doctrine with roots dating back to ancient Roman and English common law (11). This doctrine, sometimes referred to as the "wildlife trust doctrine," holds that wildlife, having no owners, are res communes, belonging "in common to all of the citizens" (12), and states have a sovereign trust obligation to manage wildlife resources for the benefit of their citizens (13). The wildlife trust doctrine is a branch of the broader "public trust doctrine," which traces its legal roots in the United States back to the mid–19th century." Mech (2012) disagreed that states had shown "hostility toward wolves," and considered Bruskotter et al's urging of courts to hold states accountable to their public trust obligations redundant. Johns (2012) noted that state legislators can overturn court decisions. He also pointed out that, although Americans favor wolf restoration two to one, those opposed to wolves have organized. Bruskotter et al (2012) responded with several examples of state governments showing hostility toward wolves, and agreed with Johns that grassroots mobilization may be vital for lasting protection of wolf populations. And those opposed...?

Gibson (2013) writes, "By the 1990s, the northern Rockies had become a redoubt for America's far-right wing extremist groups: paramilitary culture advocates who saw themselves as armed warriors facing federal tyranny, ranchers angry that they did not own the lands they leased from the federal government to graze cows, hunters who saw the region's deer and elk as private property, and those who hated all forms of environmental regulation. These groups created a common mythology, both resurrecting old forms of wolf demonization - wolves as evil, related to the devil - and inventing new ones: wolves as foreign invaders from Canada, wolves as icons of federal government, wolves as disease-ridden with deadly tape worms, wolves as 'killing machines' that would wipe out the region's livestock, and in time, hunt people for food and sport."

L. David Mech, in his 1970 book, The Wolf, wrote, "These people cannot be changed. If the wolf is to survive, the wolf haters must be outnumbered. They must be outshouted, out-financed, and outvoted. Their narrow and biased attitude must be outweighed by an attitude based on an understanding of natural processes. Finally their hate must be outdone by a love for the whole of nature, for the unspoiled wilderness, and for the wolf as a beautiful interesting, and integral part of both."

Meantime, legislators in Montana are demonstrating total ignorance of the public trust doctrine, wildlife ecology, conservation ethics, or anything related thereto. One, vetoed by the governor, would legalize silencers for wolf hunting. Another would allow 12-year olds and up to hold five wolf licenses, allow recorded sounds and calls, and would have set a wolf population cap of 250. Another would not allow the wildlife commission to prohibit the hunting or trapping of wolves adjacent to a national park or close the area to wolf hunting or trapping unless a wolf harvest quota established by the commission for that area has been met. In other words, some legislators wants to micromanage wolf hunting in total abrogation of fair chase standards; just kill wolves as efficiently as technologically possible.

Finally, why do state game departments hammer wolves, mountain lions, bears, and coyotes? Demand from their constituents, hunters who see predators as competitors; and ranchers. Hunters' license fees pay the bills, and ranchers control private lands on which much hunting takes place, so they must be placated.

We could spend months in a university class examining these issues in detail, or you could simply read, for starters, Cristina Eisenberg's The Wolf's Tooth (2010, Island Press). I also recommend reading the Yellowstone Wolf Project's annual reports, some of which can be read on the internet. Meanwhile, we can support the Yellowstone Wolf Project through donations to the Yellowstone Park Foundation. at www.ypf.org.

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